

## Use Case No 28: AGC Frequency Control

### Summary:

This use case is a description of the information exchanges between a Data Acquisition subsystem and the load frequency control core of an Automatic Generation Control system. The calculation of economic dispatch and handling of generator schedules and production cost summaries form a separate use case [undocumented at present].

The AGC Load Frequency control subsystem receives new data values from the Data Acquisition subsystem (i.e. SCADA), calculates an Area Control Error and the required changes in generating unit set points. Set point controls are sent through the Data Acquisition subsystem to the power stations. The generating unit states can be made available for other applications.

For simplicity, the information exchanges with user interfaces are not described. It can be assumed that user interfaces are notified with relevant data updates for each subsystem and provide a means of changing parameters.

### Actor(s):

Name	Role description
System Operator (= Control Engineer)	(Human) Monitors and controls system operation
Telemetry System	(External System) Provides telemetry data in the form of analogue measurements, status, or accumulator data from substation, neighboring control center, or field device.
Data Maintenance Engineer	(Human) Creates, deletes and updates data defining network and telemetry. Does not participate in this use case but is shown on the diagram for reference.

### Participating Systems:

System	Services or information provided
Data Acquisition	A SCADA application that maintains latest measurements from Telemetry System and provides data for other subsystems in a form equivalent to CIM SCADA Package. Also sends set point controls to Telemetry System
Alarm System	An application that forces notification of power system events to the human user's attention.
History/Logging	An application that records power system events.
AGC Frequency Controller	A generation application that calculates an Area Control Error and the required changes in generating unit set points. This may be part of the SCADA package, part of a larger AGC package or stand-alone.
AGC Unit Dispatch	A generation application that calculates base points for generating units. This may be based on economic dispatch and/or schedules.
Generic Application	Any application that contains a power system

	generation model. Could be study economic dispatch or unit commitment but also network applications.
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**Pre-conditions:**

All participating subsystems are operational.

The Network Modification use case has ensured the internal data is consistent between the Data Acquisition, AGC Frequency Controller and AGC Unit Dispatch subsystems.

**Assumptions / Design Considerations:**

- The Data Acquisition subsystem, the AGC Frequency Controller subsystem and the AGC Unit Dispatch subsystem have different internal representations of the power system network. They share the same identifiers for ConductingEquipment and Measurements. These identifiers may be numeric rather than character strings in order to improve performance.
- The inputs to the Alarm System and History/Logging are essentially the same.
- Timing requirements: Timing for information exchanges is given for comparison purposes only.
- Frequency of use: every 2 to 5 seconds.

**Normal Sequence:**

*(This shows in time order, the sequence of information exchanges between the subsystems)*

Use Case Step	Description
1	Telemetry System provides raw measurement set to Data Acquisition
2	Data Acquisition publishes ConductingEquipment state change events, if any, for Alarm Subsystem and History/Logging
3	Data Acquisition publishes analogue measurement limit crossings, if any, for Alarm Subsystem and History/Logging.
4	Data Acquisition notifies status change events and analogue value change events for AGC Frequency Controller. <ul style="list-style-type: none"> <li>▪ Area frequency</li> <li>▪ Tieline MW</li> <li>▪ Generator unit online/offline</li> <li>▪ Generator unit control local or remote</li> <li>▪ Generator unit MW output</li> <li>▪ Generator unit MW setpoint feedback</li> <li>▪ Generator unit MW limits</li> </ul>
6	AGC Frequency Controller calculates an Area Control Error and the required changes in generating unit set points.
7	AGC Frequency Controller publishes events, if any, for Alarm Subsystem and History/Logging <ul style="list-style-type: none"> <li>• Area Control Error states (assist, emergency)</li> <li>• Generator units not tracking</li> <li>• Loss of critical measurement</li> </ul>
8	AGC Frequency Controller sends new setpoint controls (as CIM_MeasurementValues) to Data Acquisition.

**Alternate Sequence a: AGC Unit Dispatch publishes base points**

Use Case Step	Description
1-4	As normal sequence
5	AGC Unit Dispatch sends (publishes) new set of base points for AGC Frequency Controller
6-8	As normal sequence

#### Alternate Sequence b: External application requests state information

Use Case Step	Description
1-8	As normal sequence
9	External application requests state information
10	AGC Frequency Controller creates or overwrites generation data set for export to other applications. In other words it publishes a consistent set of data that can be used by other applications whilst it continues processing.

#### Post-conditions:

All subsystems have consistent internal data.

#### References:

This complements the SCADA Data Update and State Estimation use cases.  
This use case must be preceded by a Network Modification use case.

#### Information Exchanges:

This section lists the information exchanges described in the use case regardless of the step.

ID	Producer Actor/System	Consumer Actor/System	Information Content
A	Telemetry System (Actor)	Data Acquisition	Raw measurements – analogue measurements, status, or accumulator data Uses GOMSFE and/or other protocols
Z	Data Acquisition	Telemetry System (Actor)	Set point and digital controls Uses GOMSFE and/or other protocols
B	Data Acquisition	Alarm System	Changes in states for individual Conducting Equipment. Changes in individual analogue measurement limit crossings. 0-50 per second.
B	Alarm System	History/Logging	As above
C	Data Acquisition	History/Logging	Selected analogue readings. 2000 every 30 minutes
F	Data Acquisition	AGC Frequency Controller	Status change and analogue value events (initiated by Data Acquisition) 100 every 2-5 seconds
G	AGC Frequency Controller	Data Acquisition	Generator unit set point controls 10 every 2-5 seconds

H	AGC Frequency Controller	Alarm System History/Logging	Changes in control states 0-20 per minute
N	AGC Unit Dispatch	AGC Frequency Controller	Generating unit base points 300 every 5 minutes
O	AGC Unit Dispatch	Generic Application	Snapshot of state 500 items every 5 minutes
P3	Data Definition	AGC Frequency Controller	Generation data set with identifiers of ConductingEquipment and Measurements in Data Acquisition. 5000 items every 30 days
P4	Data Definition	AGC Unit Dispatch	Generation data set with identifiers of ConductingEquipment and Measurements in Data Acquisition. 5000 items every 30 days
S	Data Definition	Data Acquisition	Telemetry modification data set. 100 items every 30 days

**Information Exchange Classification:**

This section classifies the information exchanges according to their complexity.

Type	Description of Information Exchange Messages	Ids
Fast Data Event	Single CIM entity class per message Single CIM entity instance per message Subset of CIM entity attributes Initiated by Producer application Typically a changed telemetered value	F,G
Slow Data Event	Single CIM entity class per message Single CIM entity instance per message Subset of CIM entity attributes Initiated by Producer application Typically a user entered or displayed value	
Alarm Text Event	Formatted as text for user interface Based on Simple Event plus additional information e.g. Substation.name, ConductingEquipment.name, Measurement.unit, MeasurementValue.value Initiated by Producer application	B,H
Array Data Set	Single CIM entity class per message Many CIM entity instances per message Subset of CIM entity attributes Initiated by Producer or Consumer application	C,O,N
Full Complex Data Set	Many CIM entity classes Many CIM entity instances Probably all attributes per CIM entity Includes relationships defined by keys	P3,P4
Modification Complex Data Set	Many CIM entity classes Many CIM entity instances Probably all attributes per CIM entity Includes relationships defined by keys  Each instance marked delete, insert, update	S

**Issues:**

<b>ID</b>	<b>Description</b>	<b>Status</b>
3.	Not synchronized with Network Modification use case	Open
2.	Digital filters assumed fixed time steps that may not be compatible with asynchronous publish & subscribe events.	Open
3.	Information exchange for other applications not well defined.	Open

**Revision History:**

<b>No</b>	<b>Date</b>	<b>Author</b>	<b>Description</b>
1.	19-May-99	T. Berry	Original draft for discussion based on SE03_State Estimation
2.			